



# Hypercube Update



ASNE Technical Review

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# Overview



- Hypercube Concept
- Process Flow
- Cluster computing
- Future



# Hypercube Concept



- Need: A tool to provide realistic environmental impacts on aggregate-level simulations
  - High-fidelity simulation can not be used directly
  - Low compute burden essential
  - Bridge gap between hi-fi simulation and aggregate statistics



# Hypercube Concept

$P_x = f(\text{Sensor, Target, Background, Weather, Tactics, etc.})$

$P_d$  - Probability of detection

$P_r$  - Probability of recognition

$P_i$  - Probability of identification

Physical simulation during runtime not always feasible particularly when these parameters are highly variable (e.g., clouds and background)

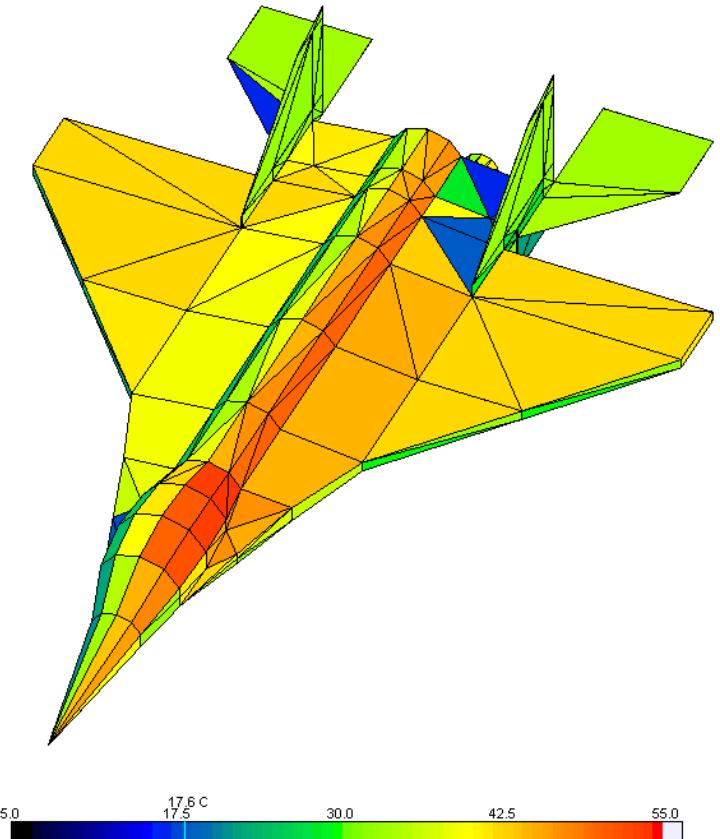
Concept: Generate probabilities prior to simulation runtime with many “virtual sorties.” Can use climatology or specific weather as input. Interpolate over resulting hypercube at runtime to get  $P_x$ .



# TAWS-A

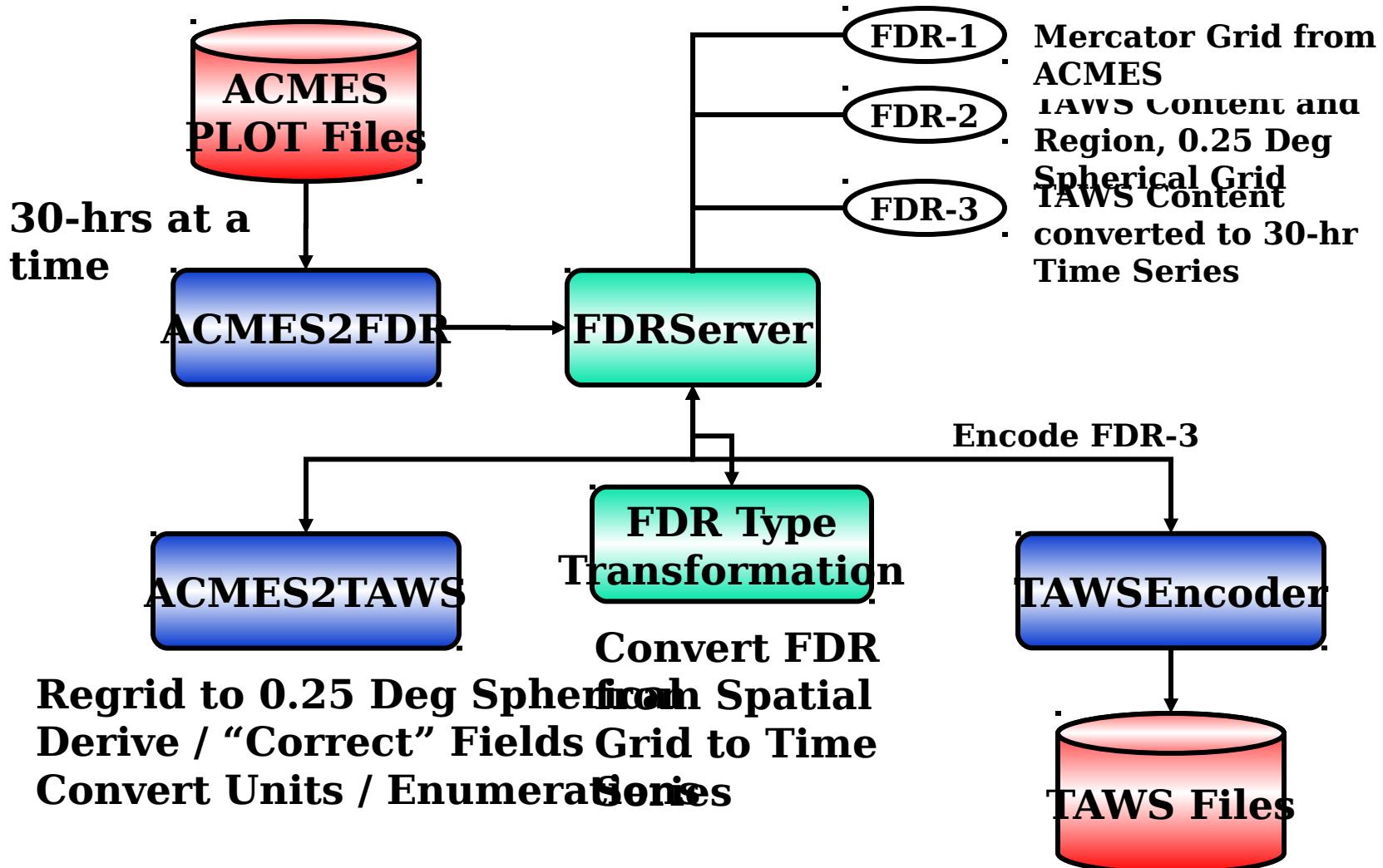


- Physical Model Core of the Operational TAWS Software
- Currently Using Infrared (IR) Model Only
- Model Uses
  - Sensor Info
  - Time of Day
  - Weather
  - Target and Background Info
- TV/NVG and Laser Future Candidates



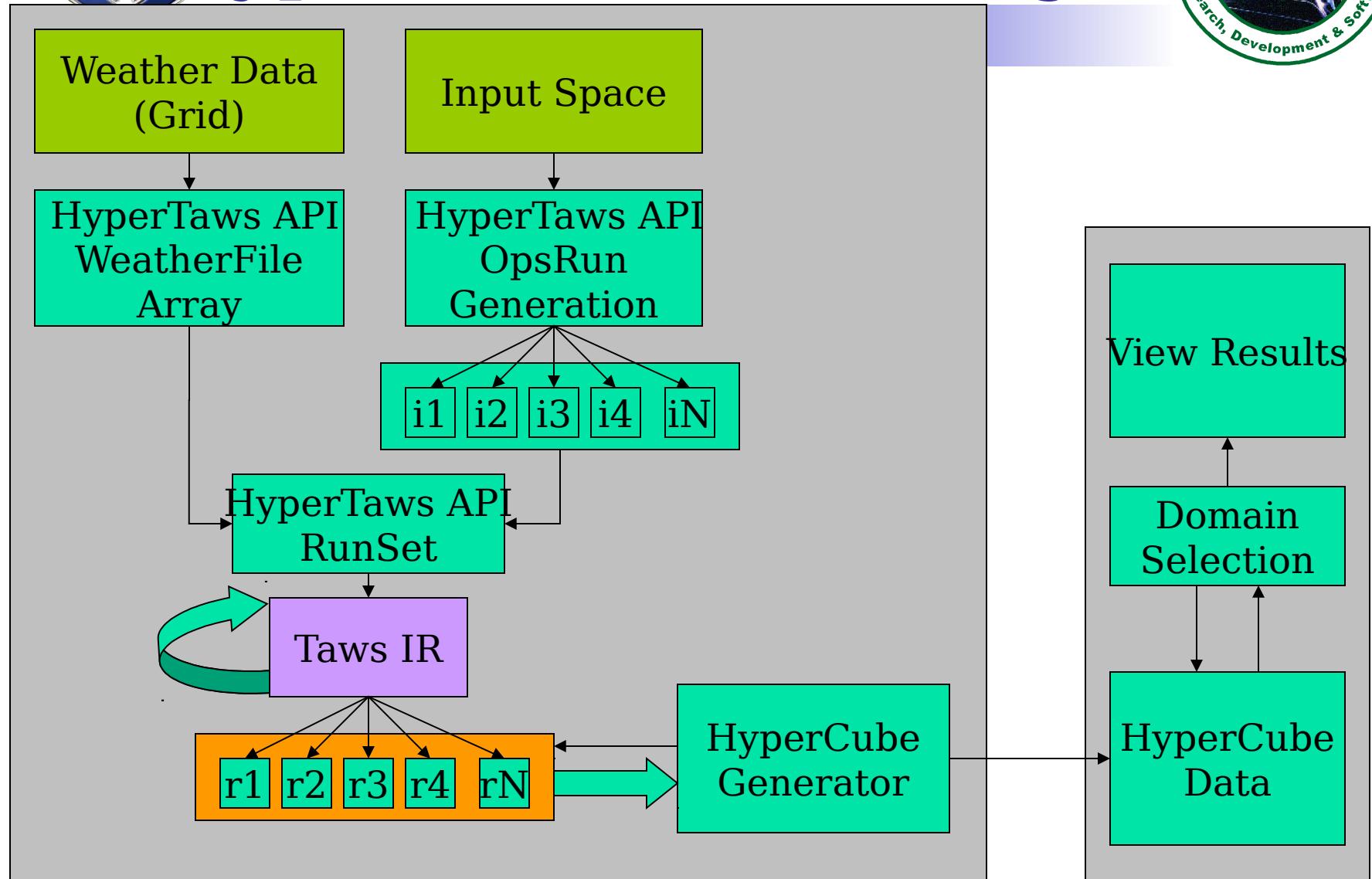


# ESG TAWS Wx Processing





# HyperTaws Flow Diagram





# Many TAWS Runs



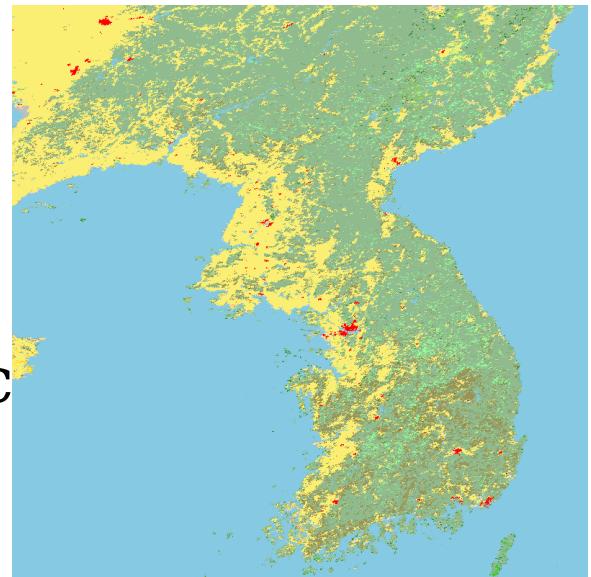
41 x 41 Grid = 1681 Weather Points/TAWS runs p

4 Months of data processed = 122 days  
January 1998, 1999 June 1994, 1996

T-62 tank target

205,082 TAWS runs

If manual 6,152,460 mouse c





# Cluster Computing



Simplified abstract indices

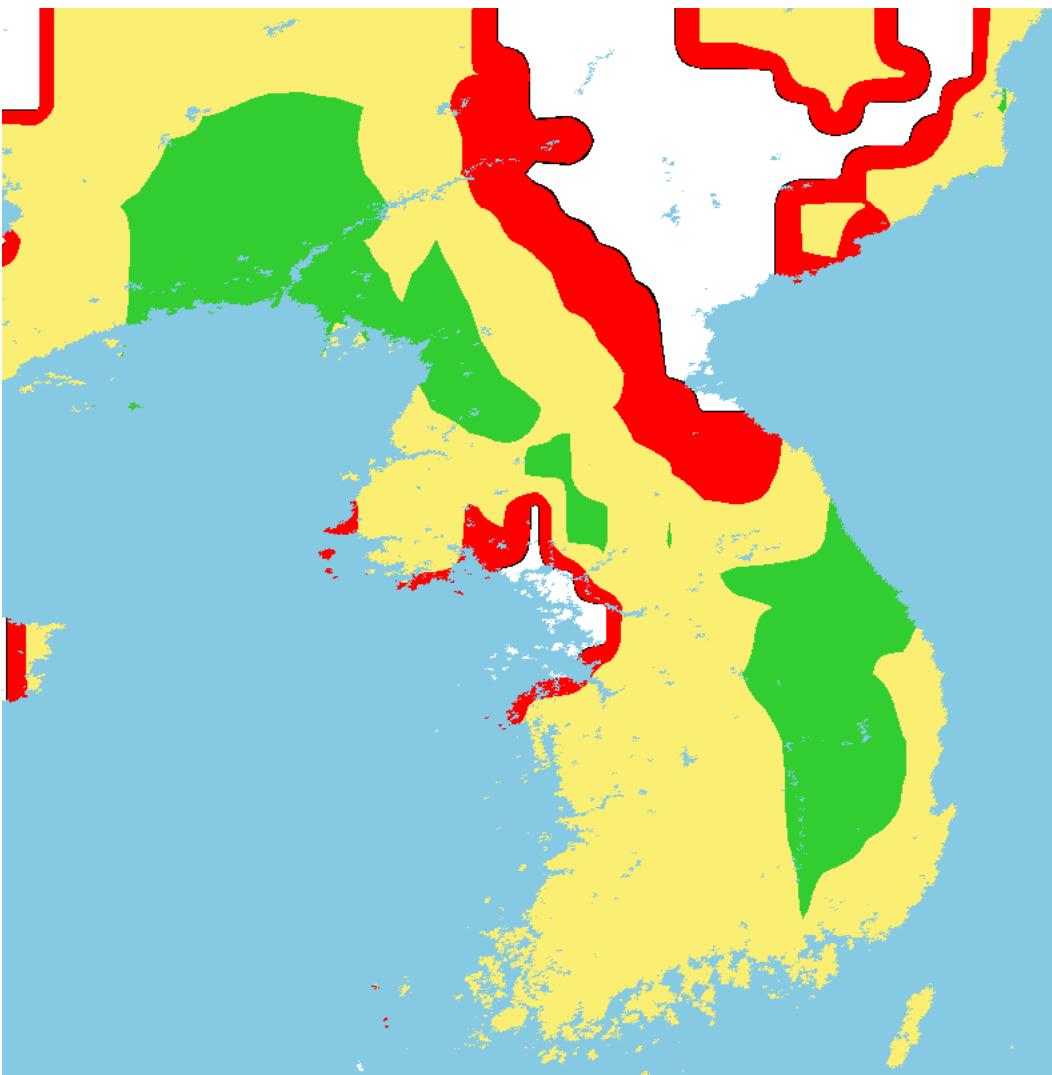
Efficient consolidation of results from cluster nodes

Verification of MPI vs. uniprocessor version

Overall efficiency improvement



# Detection Range Map

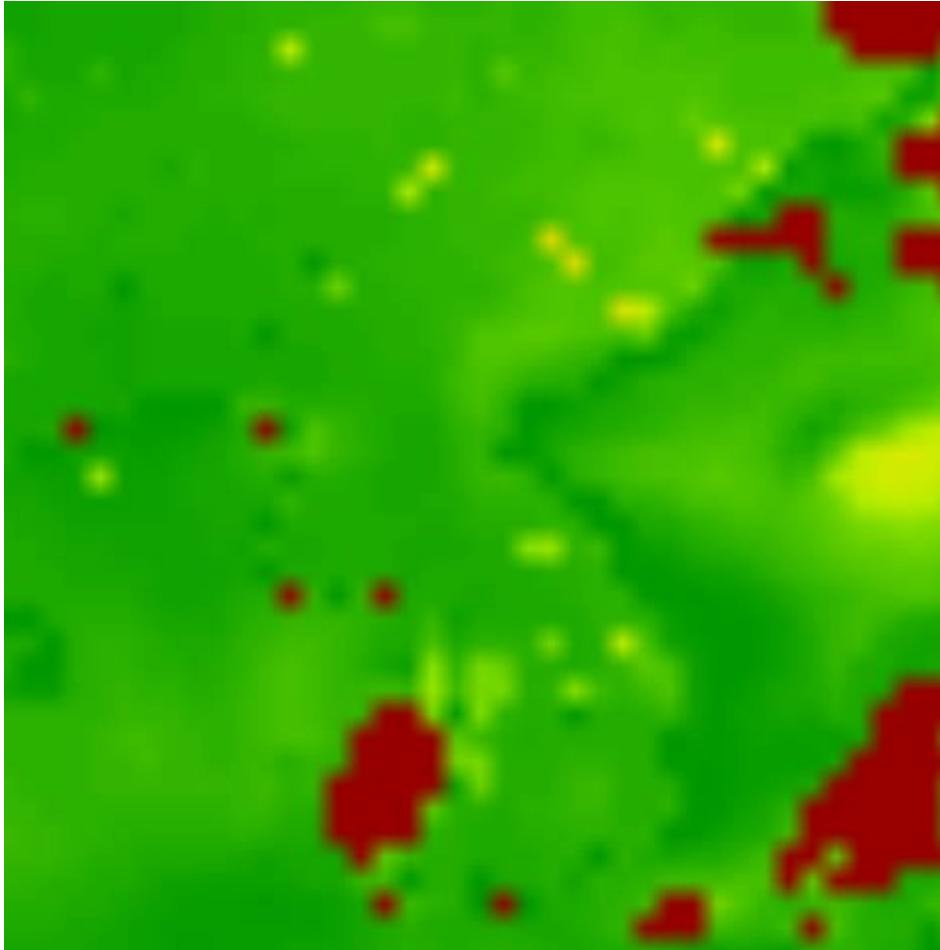


Date: Jan. 8, 1998  
Time: 1400

Target: Tank  
Altitude: 10000  
View Angle: 0 deg.



# Hypercube Animation



June 1994 Thresholded Detection Ranges - Tank ta

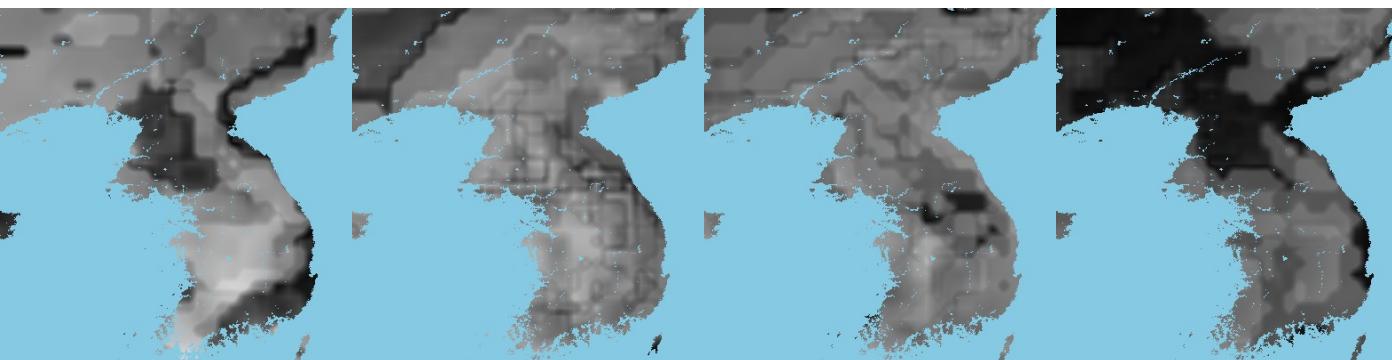


# Detection Range Statistics

Averages



0 < Red < 3.14, 3.14 < Yellow < 6.86, 6.86 < Green  
Standard Deviations: Bottom



Max: 4.15km

2-7

Max: 3.56km

8-14

Max: 3.52km

15-21

Max: 2.66km

22-31

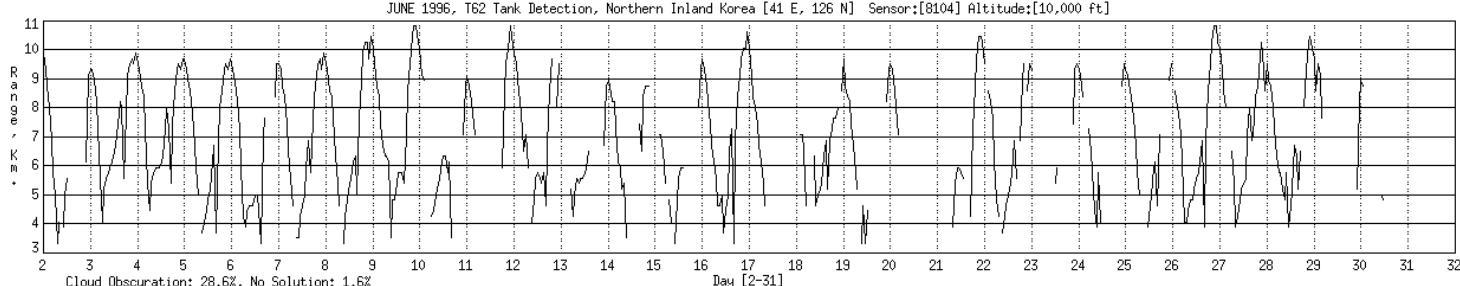
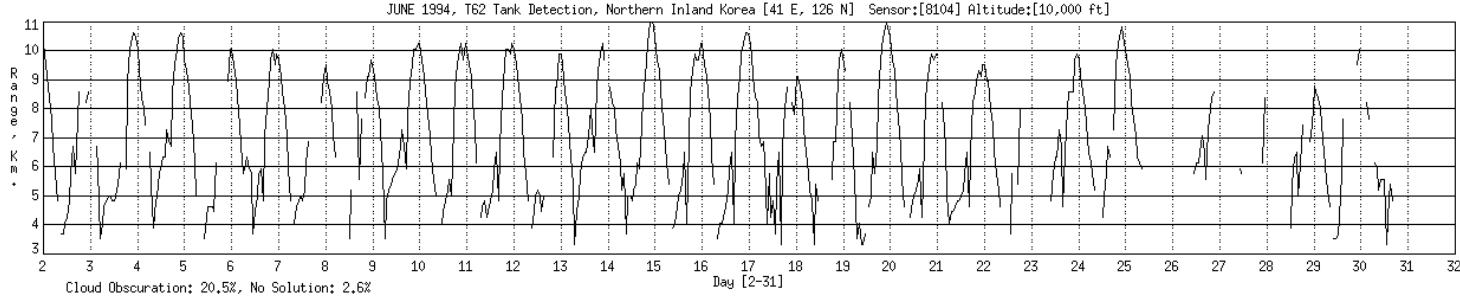
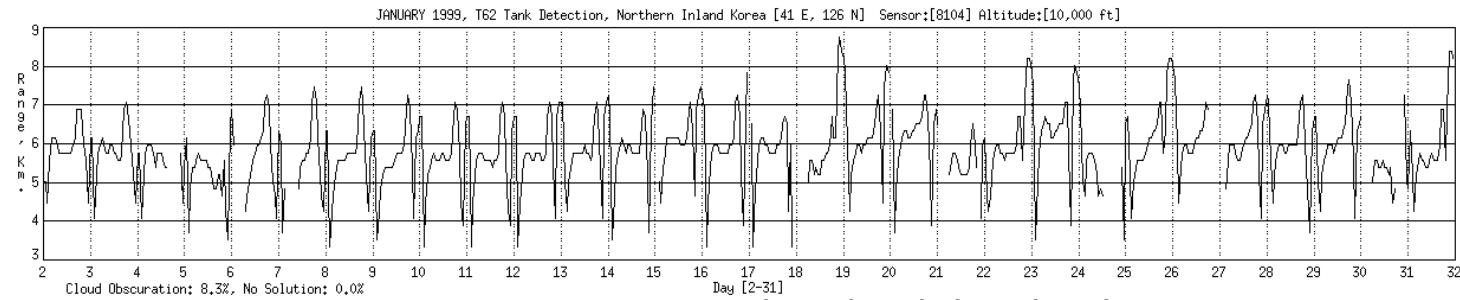
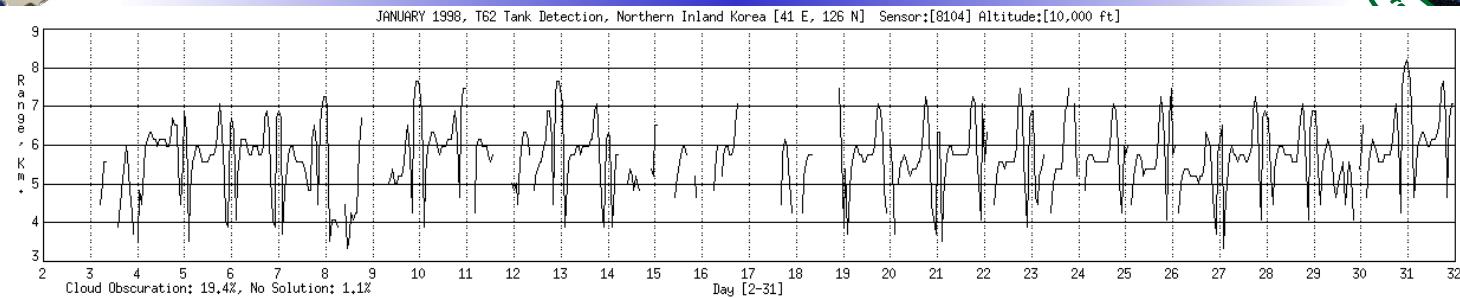
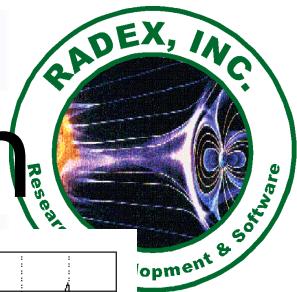
> 50,000 TAWS runs - Beginnings of an output climatology

Sensor 8104, tank, view 0deg., 0000hours

Max: 3.22km  
2-31

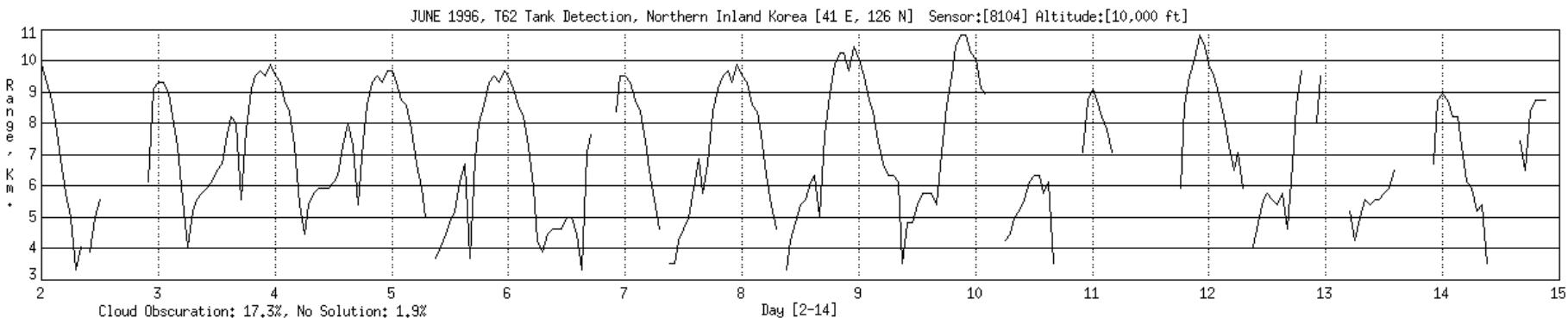
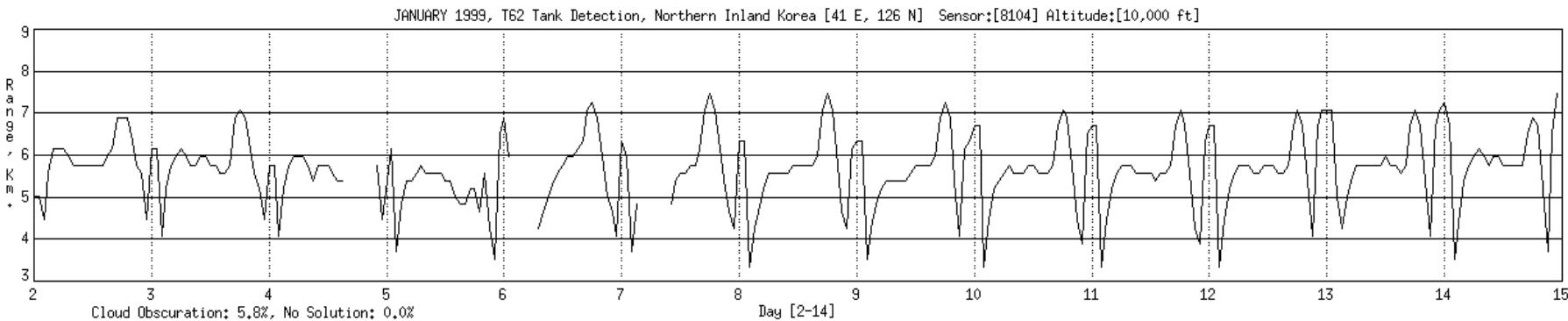


# Seasonal Comparison



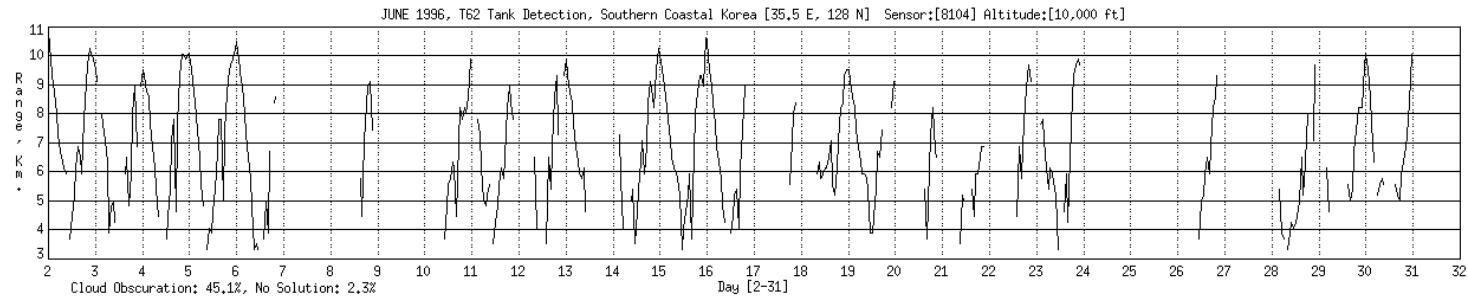
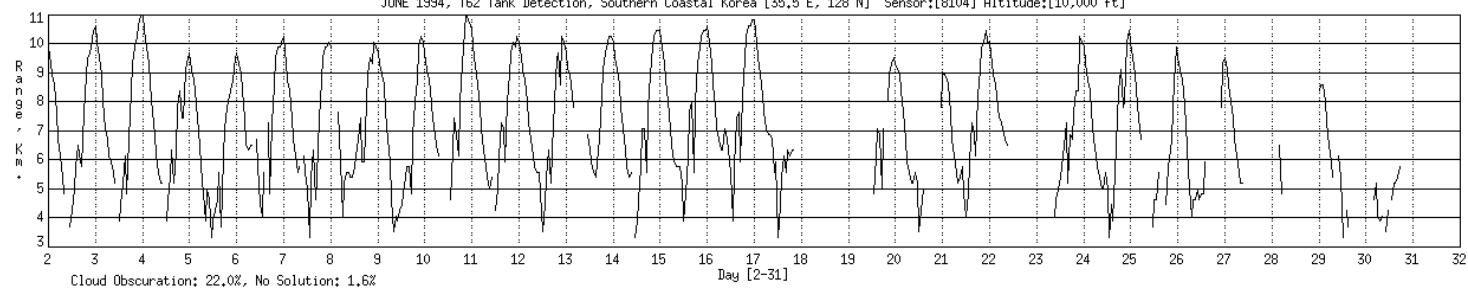
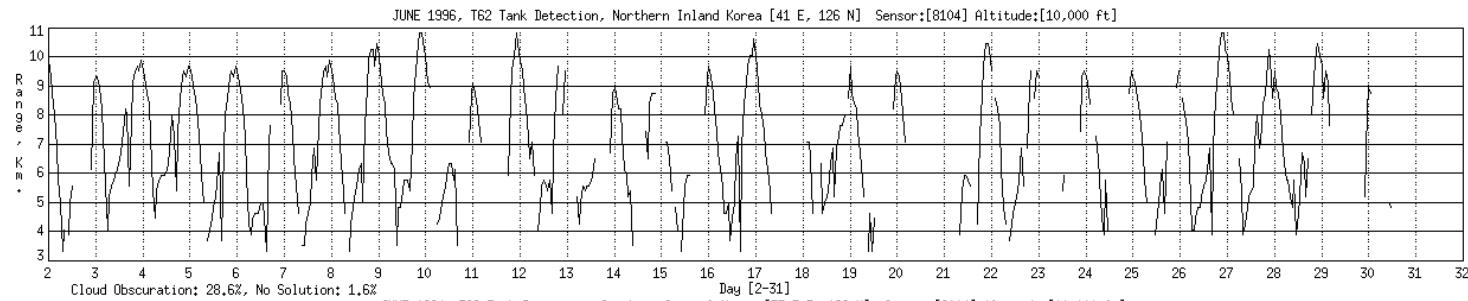
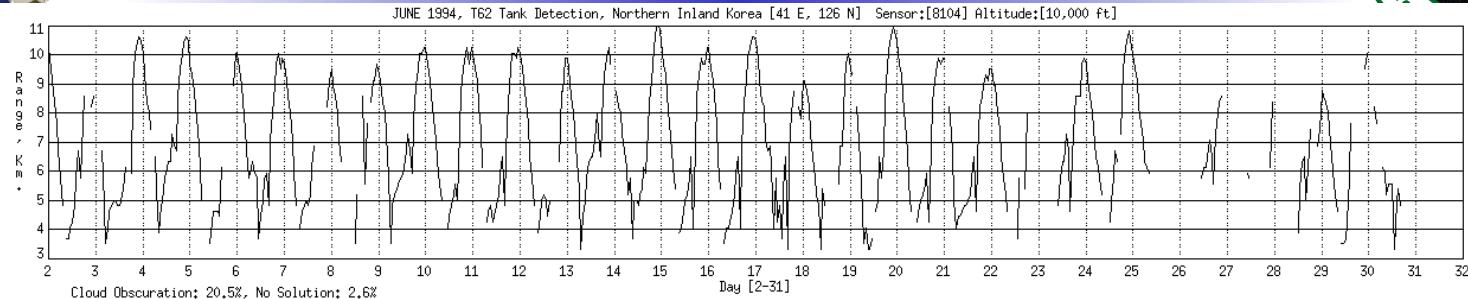
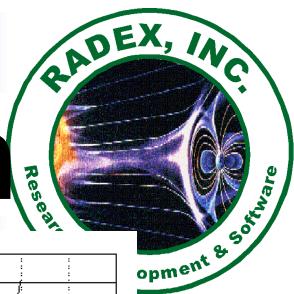


# Diurnal Cycle Closeup



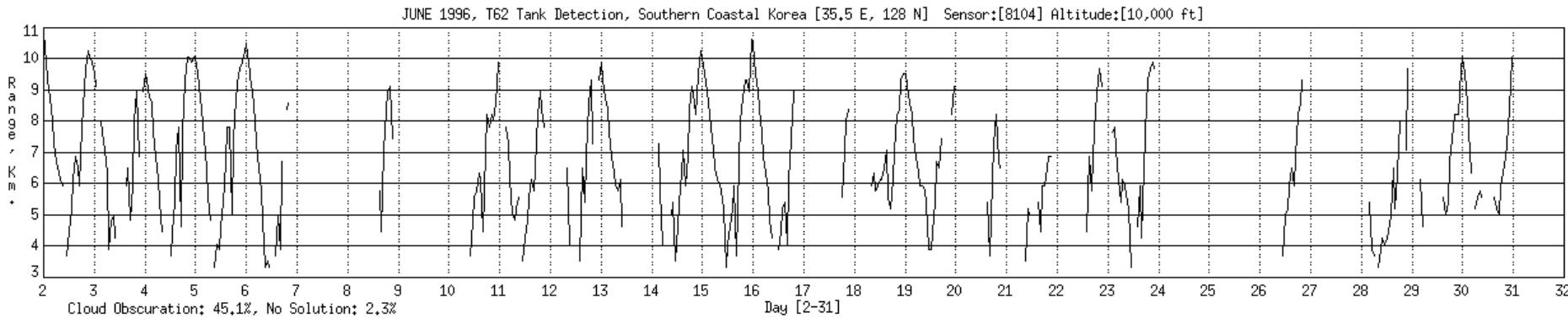
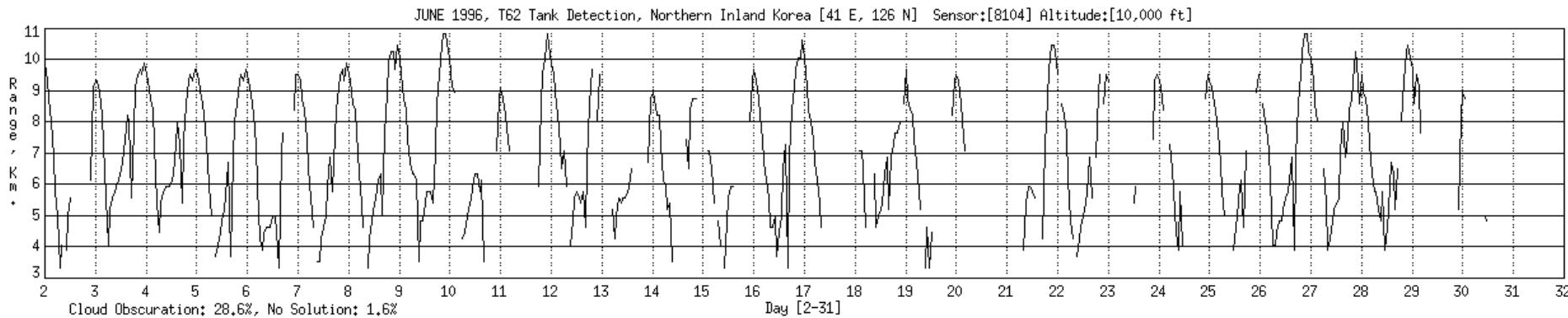


# Regional Comparison





# Regional Comparison June '96





# Future Developments



- Development slowed in favor of WxFx
- Warfighter interest in TAWS hypercube products
- Cloud Free Line of Sight/ TAWS modeling
- Output to standard mapping tools